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(72) Inventor BRIAN CONSTANTINE SEWELL

(54) IMPROVEMENTS IN OR RELATING TO OPTICAL SCANNING APPARATUS

(71) We, THE RANK ORGANISATION LIMITED, of Millbank Tower, Millbank, London, S.W.1, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to optical scanning apparatus and particularly to apparatus for optically scanning a pattern such as a pattern of colours to provide a coded signal representative of the pattern.

The term "pattern", when used in this Specification, will be understood to relate to any design in one or more colours whether regular or not and to include any artistic design. The present invention finds particular utility in relation to automatic textile machines which operate to produce a textile under the guidance of a coded signal representative of the pattern. Previously the coded signals for such machines have been produced from an original pattern by manual methods which involve dividing the pattern into regular elements and producing a coded representation of the colour occupying all of or the majority of the area of each element. These coded representations are formed for each element successively in lines across the pattern and used to provide a sequential signal representing the whole pattern. This is convenient because textile machines normally operate to form a textile in successive rows so that a signal of this type can be readily utilised by such a machine.

The coded representations of the colour or colours of the pattern are conveniently formed as binary numbers.

A British Patent by the same applicant, Patent No. 1,308,047 (Application No. 45466/69) describes one such apparatus for the automatic production of a coded signal representative of a pattern. The apparatus comprises a scanning head and a number of colour detectors the outputs of which are combined to produce a signal representative of the colour of the pattern at any particular point. One of the problems associated with the use of such apparatus, however, is the inaccuracy which arises in coding elements in which more than one colour of the pattern occur. In such a situation the colour detectors may produce a spurious signal representing one of the two colours which may or may not be the appropriate colour, depending on the relative sensitivities of the colour detectors, or alternatively may each produce a signal which represents the colour to which it is sensitive, in which case the combined outputs will represent a colour which does not occur in that element, and may not even occur in the pattern at all. In order to combat this difficulty it is necessary that both detectors produce an accurate response. Because of the finite size of the spot of light required to illuminate the object bearing the pattern to be coded, and also because of slight differences in the optical path lengths from the scanning head to the colour detectors this is not always the case, however.

According to the present invention there is provided an optical scanning device having means for directing light reflected from or transmitted through an object being scanned to at least two optical detectors in which there are provided at least two separate paths for light from the object to each said optical detector arranged so as to ensure that each detector receives an optical signal of substantially identical intensity and spectral characteristics.

This arrangement substantially reduces the

previous difficulty when each detector received light from slightly different parts of the element.

Preferably the optical scanning device includes means for illuminating the object to be scanned.

In a preferred embodiment the light guides are arranged in two groups on either side of the means for illuminating the object to be scanned and are relatively short. In such an embodiment the groups of light guides are arranged so that each group of light guides comprises at least one light guide for directing light from the object to each of the said detectors respectively. In an alternative embodiment the light paths may be provided by relatively long flexible light guides. This has the advantage that the scanning head can be movable to scan across the pattern while the colour detectors and associated equipment can be fixed thereby allowing the scanning head to be relatively lightweight.

Preferably the said light guides are formed of optical fibres, and preferably comprise a bundle of optical fibres. The term "optical fibre" will be understood to relate to any flexible light guide capable of transmitting light by successive internal reflections from one end to the other without any substantial attenuation of the transmitted intensity.

The optical fibres extend, in use of the device, from a position adjacent the object being scanned to a position adjacent the associated colour detector which may comprise, for example, a colour filter and a photo-electric detector. In this case the end of the optical fibres adjacent the object being scanned will be termed the "light receiving" end, and the end adjacent the colour detector will be termed the "light transmitting" end.

In an embodiment in which the light guides comprise bundles of optical fibres the fibres of each group may be arranged with their light receiving ends adjacent and intercalated in a substantially random manner or alternatively may be arranged with their light receiving ends adjacent and separated by a line extending in the direction of movement of the scanning device. The light received by each colour detector is then substantially independent of the direction of movement of the scanning head.

Two embodiments of the invention will now be more particularly described by way of example, with reference to the drawings accompanying the Provisional Specification, in which:

Figure 1 is a partly schematic block diagram; and

Figures 2A and 2B illustrate two alternative configurations of light guides for the embodiment of Figure 1.

With refernnce now to the drawings there is shown a scanning head generally indicated 11 which is mounted so as to be movable over an object 12 bearing the pattern to be scanned. The scanning head 11 includes a lens 13 for focussing light from a light source (not shown) transmitted to the scanning head 11 *via* a light guide 14 onto the plane of the surface of the object 12 in a light spot of a predetermined size.

On either side of the illuminated area of the object 12 there are provided two groups of flexible light guides. The groups being indicated 15 and 16 respectively. The group of light guides 15 comprises two sub-groups 15*a* and 15*b*, the sub-group 15*a* leads to an optical detector 17 and the sub-group 15*b* leads to an optical detector 18. The outputs of the optical detectors lead to a logic circuit 19 which provides a quantised output to a store 20 in which the signal representing the pattern is stored for future use.

Similarly, the group of light guides 16 is separated into two sub-groups 16*a* and 16*b*, the group 16*a* leading to the optical detector 17 and the group 16*b* leading to the optical detector 18.

Each of the groups 15 and 16 may comprise a bundle of optical fibres and the ends of the optical fibres in each sub-group *a* or *b* may be arranged side by side so that the light receiving end of the group of optical fibres has two areas one of which will transmit light to the detector 17 and one of which will transmit light to the detector 18. Alternatively the bundles of optical fibres may be intermixed so that the fibres which form elements of any one sub-group are in a random orientation with respect to the elements of another sub-group and the light transmitted to each of the detectors 17 and 18 is a representative sample of the light received at the end of the light guide 15 or 16.

Figures 2A and 2B illustrate the ends of two typical bundles of optical fibres in accordance with these two alternatives. Figure 2A shows the ends of one group of fibres 15*a* being disposed adjacent the ends of a second group of fibres 15*b*, whereas Figure 2B illustrates the situation where the bundles of fibres are intercalated with each other the shaded ends representing fibres which are connected to the detector 17 and the unshaded ends representing fibres which are connected to the detector 18. In either case each detector receives as nearly as possible the same signal since the light from the illuminated area is divided in each light guide into substantially equal portions. This assists in avoiding the generation of spurious signals due to a difference in the light received by each detector thereby rendering the operation of the apparatus more reliable.

WHAT WE CLAIM IS:—

1. An optical scanning device having

means for directing light reflected from or transmitted through an object being scanned to at least two optical detectors in which there are provided means forming at least two separate paths for light from the object to each said optical detector arranged so as to ensure that each detector receives an optical signal of substantially identical intensity and spectral characteristics.

2. An optical scanning device as claimed in Claim 1 including means for illuminating the object to be scanned.

3. An optical scanning device as claimed in Claim 1 or Claim 2, in which the light paths are provided by flexible light guides.

4. An optical scanning device as claimed in Claim 3 in which the light guides are arranged in two groups on either side of the means for illuminating the object to be scanned.

5. An optical scanning device as claimed in Claim 4 in which each group of light guides comprises at least one light guide for directing light from the object to each of the said detectors respectively.

6. An optical scanning device as claimed in any of Claims 3, 4, or 5 in which the said light guides comprise optical fibres.

7. An optical scanninig device as claimed in Claim 6 in which each light guide comprises a bundle of optical fibres.

8. An optical scanning device as claimed in Claim 7 in which the optical fibres of the groups of light guides are arranged with their light receiving ends adjacent and intercalated in a substantially random manner.

9. An optical scanning device as claimed in Claim 7 in which the fibres of the groups are arranged with their light receiving ends adjacent and separated by a line extending in the direction of movement of the scanning device.

10. An optical scanning device as claimed in any of Claims 2 to 9 in which the means for illuminating the object to be scanned includes a light guide for directing the light from a source towards the object to be scanned.

11. An optical scanning device substantially as hereinbefore described with reference to, and as shown in the drawings accompanying the Provisional Specification.

H. G. AMANN,
Agent for the Applicants.

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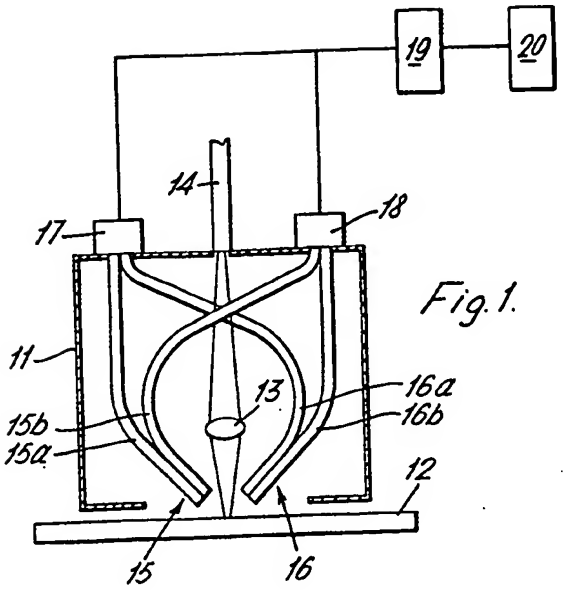

Fig. 1.

Fig. 2A.

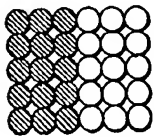

Fig. 2B.